# M009: ANCHORS

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|---|---|
| **TSP Number/Title** | M009: Anchors |
| **Effective Date** | Implement next class iteration upon receipt |
| **Supersedes TSP(s)/Lessons** | None |
| **TSP User** | The following courses use this TSP:<br>Mountain Instructor Qualification Course (MIQC)<br>Basic Mountaineering Course (BMC)<br>Assault Climbers Course (ACC) |
| **Proponent** | United States Army Alaska, Northern Warfare Training Center |
| **Improvement Comments** | Send comments and recommendations on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to:<br><br>ATTN: TRAINING ADMINISTRATOR<br>COMMANDANT USARAK NWTC<br>1060 GAFFNEY ROAD #9900<br>FORT WAINWRIGHT AK 99703-9900 |
| **Security Clearance/Access** | Public domain |
| **Foreign Disclosure Restrictions** | The Lesson Developer in coordination with the USARAK NWTC foreign disclosure authority has reviewed this lesson. This lesson is releasable to foreign military students from all requesting foreign countries with Approval of Commandant USARAK NWTC. |

## PREFACE

**Purpose**

This training support package provides the instructor with a standardized lesson plan for presenting instruction for:

| Task Number | Task Title |
|---|---|
| VIII.0400 | Anchors |

**Technique of Delivery**

| Lesson Number | Instructional Strategy | Media |
|---|---|---|
| M009 | Demonstration and Practical Exercise | None |

**This TSP contains**

**SECTION I** **ADMINISTRATIVE DATA**

**All courses including this lesson**

| Course Number | Course Title |
|---|---|
| N/A | Mountain Instructor Qualification Course |
| N/A | Basic Mountaineering Course |
| N/A | Assault Climber Course |

**Task(s) Taught or Supported**

| Task Number | Task Title |
|---|---|
| VIII.0400.A-R | Establish anchors for mountaineering operations |

**Task(s) Reinforced**

| Task Number | Task Title |
|---|---|
| VI.0200 | Risk Management for Mountain Operations |
| VIII.0200 | Mountaineering Equipment |
| VIII.0300 | Rope Management and Knots |

**Test Lesson Number**

| Hours | Lesson Number | Lesson Title |
|---|---|---|
| | M020/M021/M022 | BMC Mountaineering Review/ACC Mountaineering Review/MIQC Mountaineering Review |

**Prerequisite Lesson(s)** M005, M007, M008

**References**

| Number | Title | Date | Additional Information |
|---|---|---|---|
| | NWTC Mountain Operations Manual | FY04 | Updated yearly |
| FM 3-97.6 | Mountain Operations | November 2000 | http://www.adtdl.army.mil/ |
| FM 3-97.61 | Military Mountaineering | August 2002 | http://www.adtdl.army.mil/ |

**Student Study Assignment** Read TSP M009

**Instructor Requirements** MIQC graduate; TAITC graduate

**Additional Support Personnel Requirements** None

**Equipment Required** Instructor Equipment

- Sufficient padding

Student Equipment

- 1 x rope, dynamic kernmantle, 11mm x 50m
- 2 x webbing, nylon 1” x 5.5 ft
- 2 x webbing, nylon 1” x 9.5 ft
- 2 x webbing, nylon 1” x 25 ft
- 1 x carabineer, locking pear shaped
- 4 x carabineer, non-locking, oval steel

**Materials Required**

Instructor Materials:

- NWTC Mountain Operations Manual
- Risk Management for Mountain Operations

Student Materials:

- NWTC Mountain Operations Manual
- Risk Management Guide for Mountain Operations

**Classroom, Training Area and Range Requirements**

An area which will allow students to demonstrate the setting up of all anchors.

**Ammunition Requirements**

None

**Instructional Guidance**

Before presenting this lesson, instructors must thoroughly prepare by studying this lesson and identified reference material.

**Branch Safety Manager Approval**

| NAME | Rank | Position | Date |
|---|---|---|---|
| **Mark Gilbertson** | **GS-09** | **Training Specialist** | |

**Proponent Lesson Plan Approvals**

| NAME | Rank | Position | Date |
|---|---|---|---|
| **Peter Smith** | **GS-12** | **Training Administrator** | |

**SECTION II** **INTRODUCTION**

Method of instruction: Small Group
Type of instruction: Class
Instructor to student ratio: 1:8
Time of instruction: 5 ½ Hours
Media used: None

**Motivator**

You have received a class on mountaineering equipment and rope management and knots. The next logical step is using this equipment and rope management to establish a place to anchor personnel, equipment or set up rope installations. Selection and placement of anchors is a CRITICAL SKILL that requires a lot of field practice. Failure of any rope system is most likely to occur at the anchor point(s), unless rope damage caused the failure. If the anchor is not strong enough to support the load, it will fail. An anchor that fails can cause injury or death to personnel or loss of equipment.

**Terminal Learning Objective**

| | |
|---|---|
| **ACTION:** | Establish anchors for mountaineering applications |
| **CONDITIONS:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARDS:** | Establish anchors for mountaineering applications IAW the NWTC Mountain Operations Manual and FM 3-97.61, Military Mountaineering. |

**Safety Requirements**

Ensure that students:

- Receive a risk assessment prior to movement to the training area and before practical exercises.
- Have all necessary equipment for the PE's, to include any additional equipment required by the NWTC SOP.
- Have two full canteens and drink adequate water to avoid becoming dehydrated.
- Receive a briefing on the symptoms of heat injury or cold weather injury, as appropriate.

**Risk Assessment Level**

Determined by instructor.

**Environmental Considerations**

Backfill all holes and remove all debris created during the construction of deadman anchors.

**Evaluation**

You will be evaluated on this task during the Mountain Stakes portion of training as per the NWTC training schedule for this course.

**Instructional Lead-in**

While constructing rope installations, anchors will have to be constructed to secure the rope. Selection and construction of anchors is a critical skill that requires a lot of field practice. Failure of any system is most likely to occur at the anchor point(s). If the anchor is not strong enough to support the intended load, it will fail. We will discuss selecting the proper equipment and rigging anchors correctly in snow, ice and in snow-free environment.

**SECTION III** **PRESENTATION**

**ELO A**

| | |
|---|---|
| **ACTION:** | Tie a rope directly to a natural anchor |
| **CONDITION:** | Given a climbing rope and natural features suitable for constructing an anchor |
| **STANDARD:** | Tie a rope directly to a natural anchor IAW the NWTC Mountain Operations Manual. |

Learning Step/Activity 1 – Natural Anchors

**a. Types of natural anchors.** Trees, boulders, and other terrain irregularities should be the first choice when establishing an anchor point. They are already in place and simply require a method of attaching the rope. There are a few things to consider prior to using any natural feature as an anchor.

1. Trees in rocky terrain generally have a shallow root system. While some are strong, others are not. Tug and push on the tree to ensure it is well rooted into the surrounding earth, remember, though, you are working the soil loose as you do this. Ensure that the tree itself is not dead or rotting away.

2. Sometimes small trees and even bushes can be used as an anchor when nothing else is available. Slings can be woven through and around the root system of a number of bushes and tied off. This technique can be quite strong. Again, ensure all vegetation is healthy and well rooted to the ground.

3. Boulders and rock protrusions make ideal anchors. The rock can be firmly tapped with a piton hammer to ensure it is solid. Sedimentary and other loose rock formations are not very stable. Talus and scree fields are an indicator that the rock in the area is not very solid. Protect all ropes and webbing that could be snagged or cut from contact with the rock.

4. Whether using natural or artificial anchors, always try and select or devise one which is "Bombproof". A bombproof anchor is one which has sufficient strength for the intended load that will be placed on it. Obviously any anchor that has more strength than the climbing rope is considered bombproof. Anchor strength is also relative to the type of installation and load being placed on it. A 4 inch diameter spruce tree might be considered bombproof for anchoring a fixed rope; however, it may not be strong enough to hold the load placed on it in a suspension traverse.

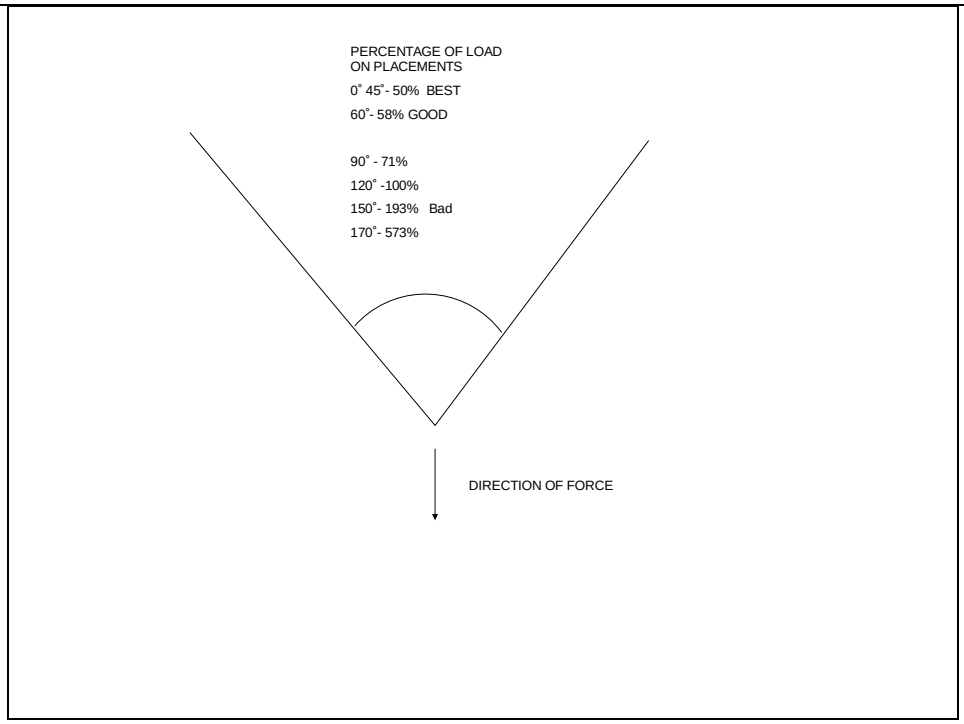
5. Padding should be used when climbing equipment (ropes and webbing) will come in contact with sharp edges of rocks, rough surfaces or tree sap. This will be demonstrated as anchors are constructed by the instructor.

**b. Loads and tension on anchors.**

1. An anchor can be constructed for a high load or a low load. A low load is generally intended for a single individual. A high load installation is one where the rope is tightened by three or more individuals or will support heavy loads.

2. The tension on the anchor can be constant or alternating. Alternating tension means that the anchor is loaded and released as the anchor is used. With constant tension the anchor is under constant load.

3. A load will stress an anchor in various ways. The angle of the sling must be less than 45 degrees in order to avoid undue stress on the protection that was placed. Angles wider than 45 degrees will actually begin multiplying the forces on the protection.

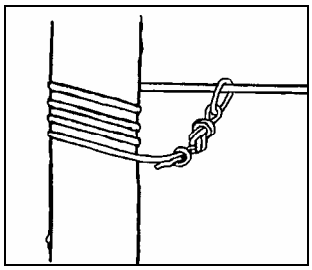



**c. Attaching the rope directly to the anchor.**

1. Sometimes the climbing rope is tied directly to the anchor; in most cases the rope is attached to a tree. Use of a bowline if preferred because it is easy to untie after it has been placed under tension. The disadvantage of using the bowline is that the knot can work itself loose over time if the tension placed on it alternates; it will require frequent inspections if this is the case.

2. **The tensionless anchor knot** can also be used; be weary of rough surfaces that could abrade the rope.

a. A figure eight loop is tied in the end of the rope.
b. The end of the rope is wrapped around the anchor three or more times.
c. The fixed loop of the figure eight is attached to the standing part of the rope with a carabiner.
d. Once the rope is under tension, the wraps should take a significant amount of the load; the figure eight loop does not have any tension on it. Use a minimum of three wraps. If there is tension on the knot, add additional wraps.
e. Avoid excess slack between the figure 8 loop and the wraps.



**NOTE:** The tensionless anchor knot is the preferred method for anchoring ropes in high load installations as this spreads more of the load to more rope length through the wraps.

**ELO B**

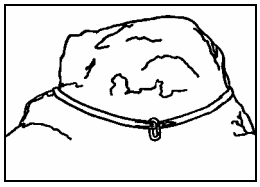
| | |
|---|---|
| **ACTION:** | Demonstrate the drape, wrap and girth methods of rigging an anchor |
| **CONDITION:** | Given an assortment of sling material, rope and terrain suitable for constructing an anchor |
| **STANDARD:** | Demonstrate the drape, wrap and girth methods of rigging an anchor IAW the NWTC Mountain Operations Manual. |

Learning Step/Activity 1 – Drape, wrap and girth methods of rigging an anchor

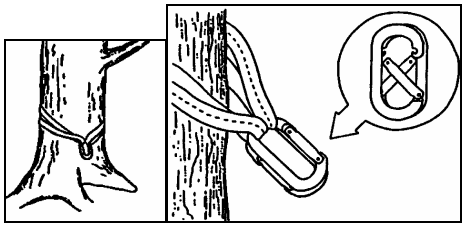
a. Under most circumstances a sling is attached to the anchor, and then the climbing rope to the sling with a carabiner(s). Three methods are used for attaching a sling to a natural anchor: drape, wrap and girth. The water knot is used to join the ends of the sling material with all of these methods.

b. **Drape.** Drape the sling over the anchor; alternatively tie the ends of the webbing around the anchor with the water knot. This method takes more time, but can be used when the top of the anchor is either out of reach or too large. This results in the same final configuration as draping the sling over the anchor.

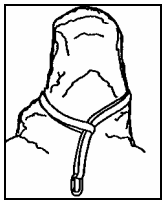
Insert a carabiner onto the sling. The carabiner gate should face away from the ground, and open away from the anchor for easy insertion of the rope. With all of these methods, set the knot in the sling off to the side where it won't interfere with normal carabiner movement, and ensure the knot will not rub on a rough surface. A single carabiner is appropriate for low loads and constant tension. For high load and or alternating tension, use two non-locking, carabiners are used with gates opposed. Correctly opposed gates should form an "X" when opened. A locking carabiner can be used in place of the opposed gate method.



c. **Wrap** the sling around the anchor and connect the two ends together with a carabiner(s).



d. **Girth.** Tie the sling around the anchor with a girth hitch. If there is a chance that the load, or rope drag, might pull the sling up and off the anchor, then the girth hitch should be used or another natural anchor selected.



**ELO C**

| | |
|---|---|
| **ACTION:** | Construct a below ground dead man anchor and attach a rope |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchor |
| **STANDARD:** | Construct a below ground dead man anchor and attach a rope IAW the NWTC Mountain Operations Manual. |

Learning Step/Activity 1 – Below ground dead man anchor

a. Any solid object can be buried in the ground and used as an anchor; this is referred to as a "dead man". Dead man anchors, are made from an object that has a large surface area and ideally some length to it. Many items can be used for a dead man anchor; a hefty timber, large rocks, a bundle of smaller tree limbs or poles, an alpine ax, a backpack are all good examples. As with natural anchors, ensure timbers and tree limbs are not dead or rotting and that boulders are solid. Construction is as follows.

1. Dig a trench 2 to 3 feet deep (deeper in loose soil) and at a right angle (90º) to the direction of pull. The trench should be dug just large enough for the anchor (timber, rock, or whatever is selected), to fit. The front wall of the trench is undercut by digging down at an angle. The trench should be dug just large enough for the anchor to fit.

2. A second trench, or rope trench, is dug from the direction of pull at ground level angling downward to the bottom of the main trench, forming a "T" with the main trench. It should be wide enough for a rope, or sling to fit in.

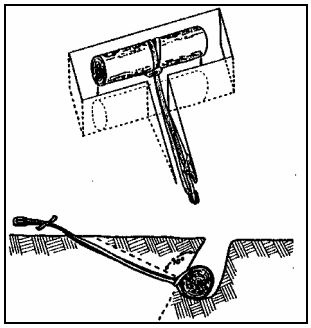
3. Ensure the vertical angle between the front wall of the main trench and the rope trench is slightly less than perpendicular (<90º). This will keep the anchor from being pulled up and out under load.

4. Place the log or other anchor in the main trench and attach a sling to it as previously described. The sling is placed in the adjoining trench. It should be slightly longer than the trench it lays in. Keep knots out of the hole for easy inspection.

5. Both trenches should be filled back in. The end of the sling is exposed for attachment of the rope and the knot in the sling is exposed for inspection.

6. The rope is attached to the sling with a carabiner(s). The gate should face up, and open away from the anchor. Alternatively, use two carabiners with opposed gates or a single locking carabiner for high load and/or alternating tension installations.

**NOTE:** If the dead man is to be reused a number of times, consider using steel cable rather than sling material. The buried sling will deteriorate over time. The main trench could also be constructed in a way allowing the middle of the log and sling to be exposed, while the remainder of the log is buried. The sling could then be easily replaced when necessary. Revetment will also strengthen the anchor.

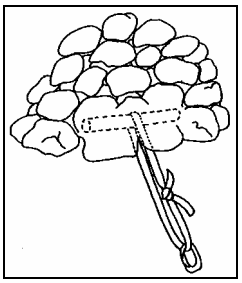


**ELO D**

| | |
|---|---|
| **ACTION:** | Construct an above ground dead man anchor & attach rope |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Construct an above ground dead man anchor & attach rope |

Learning Step/Activity 1 - Above Ground Dead Man Anchors

a. In extremely hard, rocky terrain, a variation of the dead man can be constructed by building above the ground when digging a trench would be impractical, if not impossible. The sling is attached to the anchor, which is set in the ground as deep as possible. Boulders are then stacked on top of it until the anchor is strong enough for the load. Though normally not as strong as when buried, this method can work well for low load installations, as in anchoring a hand line for a stream crossing.



**ELO E**

| | |
|---|---|
| **ACTION:** | Demonstrate piton placement |
| **CONDITION:** | Given an assortment of pitons, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate piton placement IAW the NWTC Mountain Operations Manual |

**NOTE: For this ELO students should be familiar with the concept of lead climbing, to include racking, belaying and placing and removing protection on lead and while following.**

Learning Step/Activity 1 – Placing Pitons

Locate a crack in the rock that will admit one of the piton types. Tap the rock around the crack with the piton hammer. Good, solid rock will emit a fairly sharp, high-pitched sound. Loose or rotten rock will sound dull or hollow. Avoid placements in loose rock; try and find another spot.

Solid rock may still have some dirt, moss, or loose rock in and around the crack. This should be cleaned out using the point of the piton hammer or the piton itself. A crack for a strong placement should taper down smaller below the piton. Consistent crack size is okay. A piton will likely pull out if the crack widens beneath the placement.

In hard, solid rock, the crack should admit 1/3 to 1/2 of the piton blade before hammering. If the piton can be placed in the crack almost to the eye before hammering, it probably won't seat well. Conversely, if the blade can barely be inserted by hand, the piton is either too big for the crack, or the piton will "bottom out" because the crack is too shallow for the piton.

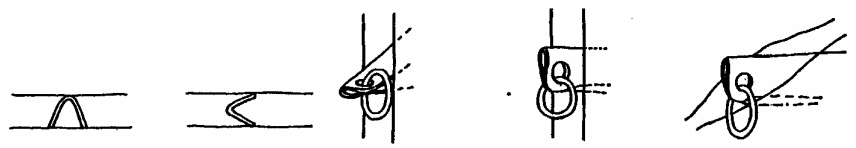
Drive the piton into the rock with the hammer. Watch the rock to ensure it is not being weakened by the hammering or the crack is not growing. The piton should go further into the rock with each blow of the hammer. A sharp sound that remains steady, or increases in pitch, should be heard. A dull sound that decreases in pitch or suddenly sounds hollow indicates a poor placement. Pitons with rings will not make the same sharp sounds as fixed eye pitons; however changes in pitch can still be noticed to indicate a strong or weak placement. The greater the resistance overcome while driving the piton, the more firm the placement will be.

Use the shoulder as much as possible when driving the piton. This will reduce arm fatigue. Drive the piton in all the way to the eye.

Once the piton has been driven in, test the placement. Stand off to the side, to avoid being hit, should the piton unexpectedly pop out. Pull on the rack loop connected to the piton with your arm, NOT your whole body. Jerk vigorously upward, downward, to each side, and then outward while observing the piton to see if it moves. Repeat if the test is questionable. Tap the piton; if the pitch has changed appreciably drive the piton in as far as possible; if the sound regains its original pitch, the piton is probably good. If the piton shows any sign of moving or if upon re-driving it there is any question of its soundness, the piton size or type is incorrect. It is very important to be in a secure position when testing the anchor.

Once the piton is placed, remove the rack loop and carabiner from it. Take a separate carabineer off the rack and clip it to the piton. The gate should face away from the rock and open down for easy insertion of the rope or sling. The placement is now ready for use.

When placing pitons, as with any anchor, the direction of pull, or load, on it must be considered. The blade of the piton should be at a right angle (90º) to the direction of pull. While a rock piton is tested in all directions, a load directly in line with the blade (out) should be avoided. Select placements that will best support the direction of pull on the anchor.



**Correct** **Incorrect** **Correct** **Incorrect**

**Correct**

**Angle Placement**

**Note:** When placing angle pitons, ensure the legs of the angle are in contact with the same side of the crack, if placed differently, strength loss will be severe.

**ELO F**

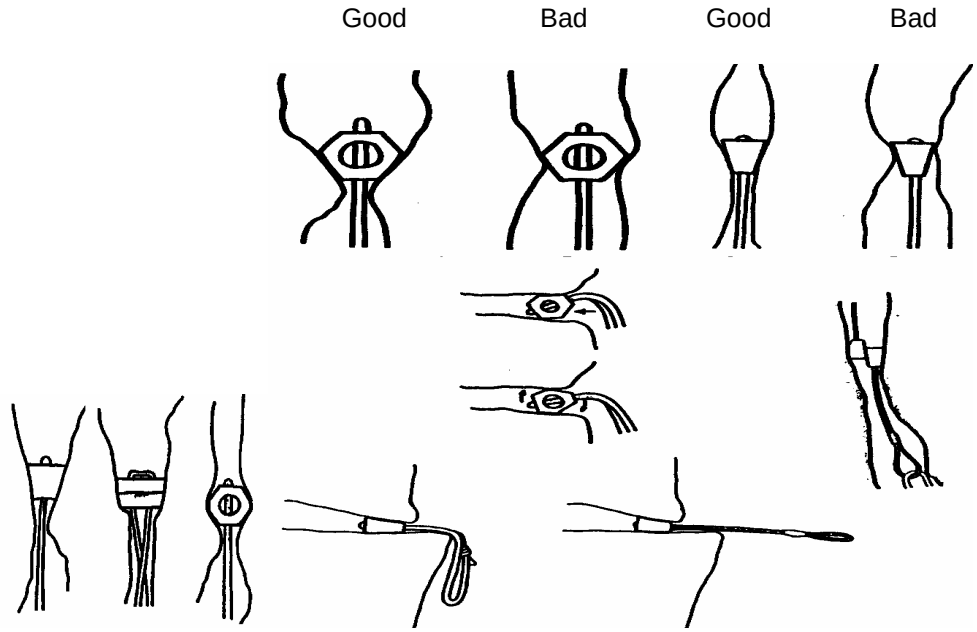
| | |
|---|---|
| **ACTION:** | Demonstrate wire stopper placements |
| **CONDITION:** | Given an assortment of wire stoppers, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate wire stopper placements IAW the NWTC Mountain Operations Manual |

**NOTE: For this ELO students should be familiar with the concept of lead climbing, to include racking, belaying and placing and removing protection on lead and while following.**

Learning Step/Activity 1 - Wire Stoppers

First examine the rock. Placements should be made in solid rock. A piton hammer could be carried to test the soundness of the rock, but normally the experienced climber will simply study and "feel" the rock. Look for crumbly, loose, or flaking rock, in and around the crack, all of which should be avoided for a placement.

Use your hand to grab, tug, and feel for the soundness of the rock. Look for a solid constriction in the crack for the placement. Avoid constrictions formed with small rock crystals. The crystals may crumble under a load, causing placement failure. For cleaning out dirt, loose rock, or moss from a crack, it's a good idea to carry a nut pick or nut tool, available commercially for removing stubborn chocks placements and cleaning cracks. A piton or a lightweight tent-stake or other homemade device could be used also.




Always think of the direction of pull, or where the load will come from, when selecting a spot for a placement. Look for the strongest possible placement, and then figure out what size chock should fit, rather than pulling a chock off the rack and trying to find a place to put it. Select the chock that will have the greatest surface area in contact with the rock. Once a likely spot is found, use the following procedure:

a. Get in a stable, balanced position.

b. Select the stopper of the appropriate size.

c. Remove the carabiner with the entire stopper set attached.

d. Place a stopper into the wider portion of the crack.

e. Grasping the carabineer, pull and "set" the stopper into the narrower portion of the crack. Pull and set in the direction that the load will come from. The wire stopper should have maximum metal to rock contact.

f. Tug a few more times to test the placement. Pull with the arm, NOT the whole body. While testing the placement, remain in a stable, balanced position, in case the stopper should "pop out". If it fails, try and rearrange the stopper so it will hold, or select another size of chock or another spot for the placement.

g. Once the chock is set, and you are satisfied with the placement, remove the rack carabiner and remaining chocks. Place the set back on the rack.

h. Remove a free carabiner, (with the gate facing away from the rock and opening down) or a complete runner from the rack and attach it to the chock with the hanging carabiner gate facing away from the rock. The placement is now ready for use.

**ELO G**

| | |
|---|---|
| **ACTION:** | Demonstrate hex centric chock placements |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate hex centric chock placements IAW the NWTC Mountain Operations Manual. |

**NOTE: For this ELO students should be familiar with the concept of lead climbing, to include racking, belaying and placing and removing protection on lead and while following.**

Learning Step/Activity 1- Hex centric chocks

Hex centric chocks are placed the same as ELO 6 wire stoppers. The main difference with hex centric chocks is that the placement may be passive in nature as with the wire stoppers or they may be placed so that there is a camming action to the chock that increases the stability of the placement as a load is placed upon it.

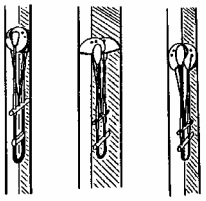
**ELO H**

| | |
|---|---|
| **ACTION:** | Demonstrate SLCD placements |
| **CONDITION:** | Given an assortment of SLCDs, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate SLCD placements IAW the NWTC Mountain Operations Manual. |

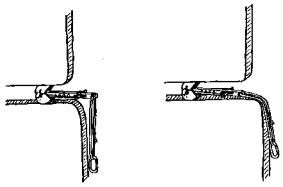
**NOTE: For this ELO students should be familiar with the concept of lead climbing, to include racking, belaying and placing and removing protection on lead and while following.**

Learning Step/Activity 1

**SLDC Emplacements**



**A B C**



**A- Bad B- Good**

**A- BAD, cams fully contracted**

**B- BAD, cams fully expanded**

**C- GOOD, cams at good angles**

**A- If loaded, shaft will take the force**

**B- If loaded, cams will take the force**

a. As mentioned earlier, the main advantage of the SLCD is for anchor placements in wide, parallel sided or flaring cracks. SLCD's come in various sizes, each of which fits a certain range of crack widths. The basic principles for chock placement apply to placement of an SLCD. Direction of pull in vertical cracks must be in line with the shaft of the SLCD.

1. Select a spot for placement of the SLCD.

2. Pull on the lever allowing the cams to contract.

3. Place the SLCD in the crack with the shaft in line with the direction of the load.

4. Release the lever allowing the cams to expand.

5. Grasping the sling, or carabiner, PULL and "SET" the SLCD in place.

6. Tug a few times to test the placement. Again, ensure it is set with the shaft in line with the load.

b. Camming devices have been known to "walk", or creep deeper into a crack as a result of rope action through the carabiner, making it difficult to reach the lever for removal. A SLCD should only be placed deep enough in the crack for all the cams to make contact with the rock.

c. A SLCD should not be placed with the cams fully contracted. It may not expand properly under load and there will be no room to release the lever for removal. Also, the cams should not be allowed to expand back to their maximum width. Though not obvious, the device will not hold well without the ability to expand more under load. In each of these cases, select a different size SLCD, or another type of chock.

d. SLCD's must be used as they were intended; as an expansion device. Never use it like a regular chock by wedging the flat sides of the cams into a crack. Material strength was not designed into the device for use in this manner. It could easily break under load.

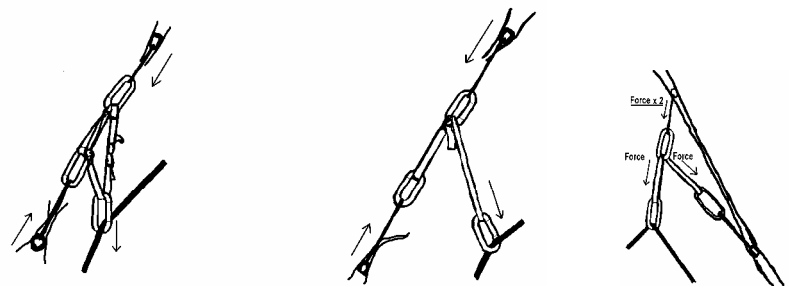
e. Older style SLCD's were constructed with a solid metal shaft. When used in horizontal cracks, the shaft must not be allowed to "hang out" over the edge. The shaft will snap off under load. In this case, the SLCD must be set further back in the crack so the sling hangs over the edge. Most SLCD's are currently being manufactured with shafts made of steel cable, instead of solid metal, to eliminate this problem.

**ELO I**

| | |
|---|---|
| **ACTION:** | Demonstrate combination placements (multidirectional anchors) |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate combination placements (multidirectional anchors) IAW the NWTC Mountain Operations Manual |

**NOTE: For this ELO students should be familiar with the concept of lead climbing, to include racking, belaying and placing and removing protection on lead and while following.**

Learning Step/Activity 1 – Multidirectional anchors: Combination placements.




(CORRECT) (CORRECT) Figure 3 (INCORRECT)

a. Sometimes it seems almost impossible to set a chock in a crack so that it will support the load in the right direction. This is especially true when horizontal cracks are used and the direction of pull is downward. In a vertical crack, the load might be outward as well as down. Placements in diagonal cracks can often pose an interesting problem as well. In any case, if a single placement will not properly support the load, two or more chocks may be used in combination to devise an anchor that will accept a load in multiple directions without failing. Normally, when a combination placement is used, the chocks are in opposition to each other. One of the placements will support the actual load. The

other placement(s) primarily keep the main load chock in place. Sometimes the chocks keep each other in place and both support the load. The ability to place chocks in opposition is an important part of safe climbing. For this explanation visualize a vertical crack at the bottom of a climb:

1. Place a piece of protection that is set for the down direction. Clip a carabiner to it.
2. Place a second piece of protection below the first piece; this piece should be set for the up direction. Clip a carabiner to this piece.
3. There are two ways to complete the multidirectional anchor:

a. See Figure 1. Clove hitch a runner to the carabiner on the second piece of protection. Now pull the runner tight toward the first piece of protection and clove hitch the runner to the carabiner on the first piece of protection. Clip a third carabiner to the sling material and pull the anchor in all directions- the anchor should not fail. The anchor is ready to use.

b. See Figure 2. Clip a runner to the carabiner on the second piece of protection. Now pass the runner through the carabiner on the first piece of protection and pull the runner tight. While holding the runner tight to this carabiner tie an overhand around the bend in the carabiner. Now clip a third carabiner to the remaining portion of the sling. Pull this carabiner in all directions – the anchor should not fail. The anchor is now ready to use.

Note that some climbers refer to this anchor method as a zipper stopper.

For both methods the runner must be tight between the two pieces of protection. The clove hitches or overhand knot prevent a mechanical advantage from being levered on one piece of protection (See Figure 3). This mechanical advantage places two times the force on a single point of protection and will cause the anchor to fail.

**ELO J**

| | |
|---|---|
| **ACTION:** | Demonstrate bolt/hanger placement |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Tie a rope directly to a natural anchor. Rig slings around natural anchors and attach a rope. Construct and rig a rope to a dead man anchor. Demonstrate piton placements, wired stopper placements, hex centric chock placements, dead man anchor in snow, snow picket placement, bollard construction in snow / ice, ice piton / snarg placement, ice screw placement, combination placements, and anchor equalization |

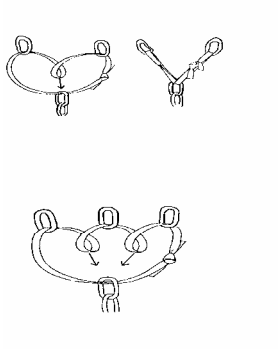
Learning Step/Activity 1 - Bolt and Hangar Placement

a. Bolts are often used in fixed-rope installations and in aid climbing where cracks are not available. Bolts provide one of the most secure means of establishing protection. The rock should be inspected for evidence of crumbling, flaking, or cracking, and should be tested with a hammer. It is a time-consuming and difficult process that requires drilling a hole in the rock, which is deeper than the length of the bolt. This normally takes more than 20 minutes for one hole and requires a hand drill with masonry bit and piton hammer or a specialized rock hammer drill with batteries. A hanger (carrier) and nut are placed on the bolt; the bolt is inserted and then driven into the hole. A climber should never hammer on a bolt to test or "improve" it, since this permanently weakens it. Bolts should be used with carriers and runners. Some versions are available in which the sleeve is hammered and turned into the rock (self-drilling), which bores the hole. Split bolts and expanding sleeves are common bolts used to secure hangers and carriers. Surgical tubing is useful in blowing dust out of the holes. Safety glasses should be worn when drilling holes.

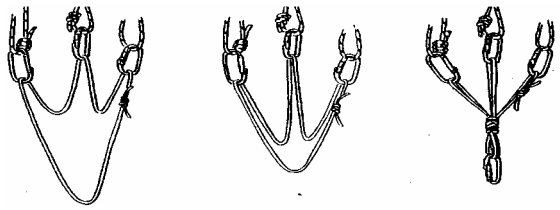
**ELO K**

| | |
|---|---|
| **ACTION:** | Demonstrate anchor equalization |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate anchor equalization IAW the NWTC Mountain Operations Manual. |

Learning Step/Activity 1 - Multi-Directional Anchors



**Multi- directional, extending**



**Directional, non-extending**

a. An equalized anchor is designed to turn two or more "less than ideal" anchors into one solid, bombproof anchor. Pitons, chocks, even small trees and bushes, can all be rigged in a manner allowing each separate anchor point to absorb only a portion of the load. Equalized anchors can also be used for light load installations when individual anchor points are questionable. For very high loads, two separate equalized anchors could be installed and a third sling could be used to equalize the load between the two. The angle placed upon the two outer most pieces of protection in an equalized system must be less than 90 degrees. Angles greater than 90 degrees will cross-load the points of protection and defeat the purpose of the equalized anchor. There are two types of equalized anchors, extending and non-extending:

1. An **extending anchor** is a multi-point equalized anchor in which the direction of force can change, (multi-directional) without changing the amount of force distributed on each point. Extending equalized anchors are designed to distribute the load evenly between the anchor points. Failure of one piece will shock load the rest. To rig the anchor:

a. Place the protection at two or more points.

b. Choose a sling long enough for the job. A good rule of thumb is that the sling be at least three times the length of the distance between all of the points of protection.

c. Clip the sling into each point of protection. Place a half twist in the webbing between each point of protection, pull down on each half-twist and clip them and the main portion of the sling into a locking carabiner. The half twist prevents the locking carabiner from falling off the remaining anchors should one point of protection fail.

2. A **non-extending anchor** is a multi-point equalized anchor in which the direction of force does not change, (unidirectional). If an individual anchor piece of a non-extending anchor comes loose, the force the failed anchor supported will be transferred to the remaining anchor pieces, with no shock load or extending of the system. However, at his point, the initial system has failed.

a. Place the protection at two or more points.

b. Choose a sling long enough for the job. A good rule of thumb is that the sling be at least three times the length of the distance between all of the points of protection.

c. Clip the sling into each point of protection. Pull down on the sling between each point of protection and tie an overhand knot in the sling material. Ensure that the direction of pull equally loads all points of protection.

**ELO L**

| | |
|---|---|
| **ACTION:** | Demonstrate a dead man anchor in snow |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate a dead man anchor in snow IAW the NWTC Mountain Operations Manual. |

Learning Step/Activity 1 - Dead Man Anchors in Snow

Dead man anchors can be constructed from snowshoes, skis, backpacks, sleds, or any large items. A stuff sack filled with snow may also be used. Ensure the attaching point is accessible before burying. The direction of pull on long items such as a picket or ax should be at a right angle to its length. The construction is identical to that of the dead man used in earth ELO C. The depth of the snow trench may need to be deeper, depending upon the consistency of the snow.

**ELO M**

| | |
|---|---|
| **ACTION:** | Demonstrate snow picket placement |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate a snow picket placement IAW the NWTC Mountain Operations Manual. |

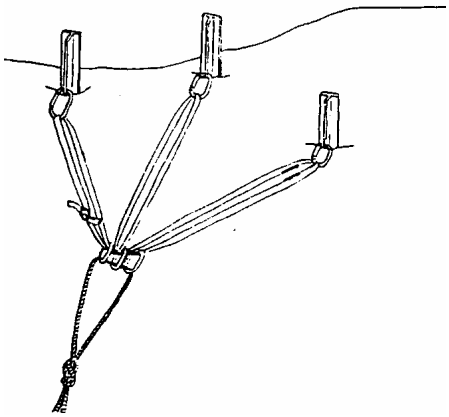
Learning Step/Activity 1 - Snow Pickets

The picket is driven into the snow at 5º-15º off perpendicular from the lower surface. If the picket cannot be driven in all the way to the top hole, the carabiner should be placed in the hole closest to the snow surface to reduce leverage. It may also be tied off with a short loop of webbing or rope.

An ice ax can be used in place of a picket. When using an ice ax as a snow anchor, it should be inserted with the widest portion of the ax shaft facing the direction of pull. The simplest connection to the ax is to use a sling or rope directly around the shaft just under the head. If using the leash, ensure it is not worn or frayed or cut from general use and is of appropriate strength and does not twist the ax when loaded. A carabiner can also be clipped through the hole in the head.

Learning Step/Activity 2 - Equalized Anchors

As with multipoint anchors on rock, two or more snow pickets can be joined together with a sling rope or webbing to construct one solid, equalized anchor. Snow and ice anchors must be constantly checked due to melting and changing snow or ice conditions. Whenever possible, two or more anchors should be used. This is not always practical for intermediate anchor points on lead climbs or fixed ropes, but should be mandatory for main anchors at all belay positions, rappel points, or other fixed rope installations. After the pickets are placed the anchor is finished in the same manner as described in ELO K. Figure 1 is an example of three snow pickets configured into an equalized anchor.



Equalized Anchor using pickets

**ELO N**

| | |
|---|---|
| **ACTION:** | Demonstrate snow fluke placement |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate snow fluke placement IAW NWTC Mountain Operations Manual. |

Learning Step/Activity 1 - Snow Fluke Placement

Wired snow anchors or flukes consist of a light metal plate similar to the blade of a shovel with a wire sling attached. When driven at a 40 degrees angle into the snow, a pull on the fluke forces the blade deeper into the snow. Wired snow anchors should be used in pairs and equalized.

Note: Bury the fluke deep, but also dig a slot in the snow to permit the cable to pull in as direct a line as possible.

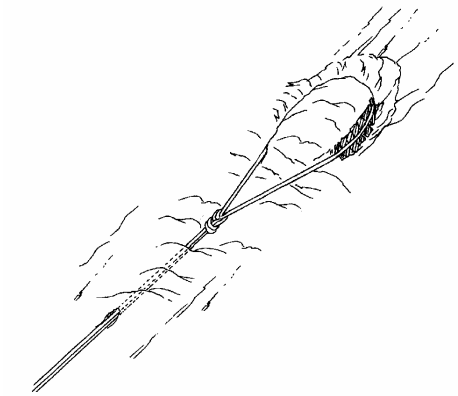
**ELO O**

| | |
|---|---|
| **ACTION:** | Demonstrate bollard construction in snow |
| **CONDITION:** | Given ice axe, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate bollard construction in snow IAW the NWTC Mountain Operations Manual. |

Learning Step/Activity 1 -The Bollard in snow

a. This is an artificial anchor shaped generally like a horseshoe; It is formed from snow and constructed with the ice ax. In effect, you are improvising a boulder in the snow. Here is how to construct one:

1. Lay out the bollard in the shape of a horseshoe. When constructed of snow, the width should not be less than 3 feet for well bonded, hard packed snow and ten feet or more for snow that is not well consolidated.
2. Using the adze of the ice axe, cut a trench 1-1.5 feet deep and 6-8 inches wide. Undercut the trench towards the center of the horseshoe to prevent the rope or webbing from sliding up over the horseshoe when loaded.
3. The middle of the climbing rope or a loop of webbing is draped over the bollard. The backside of the bollard can be reinforced with ice axes, pickets, or other equipment for added strength.



Snow Bollard

**ELO P**

| | |
|---|---|
| **ACTION:** | Demonstrate ice piton and snarg placement |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate ice piton and snarg placement IAW the NWTC Mountains Operations Manual. |

Learning Step/Activity 1- Ice piton and snarg placement

a. Ice pitons are used to establish anchor points on ice and in glaciated terrain. The ice piton is not seen in modern ice climbing but may still be available to the military. The standard ice piton is made of tubular steel and is 10 inches in length. Ice pitons installed in pairs are a bombproof anchor, however, ice pitons have no design feature, such as threads for friction, to hold them in the ice once placed and are removed easily. Safe use of ice pitons requires placement in pairs. Follow the instructions below for placing ice pitons in pairs:

1. Cut a horizontal recess into the ice; create a vertical surface as you do this. This "area" when finished, should have two clean surfaces at 90º from each other.
2. Drive two pitons, one into the horizontal and the other in the vertical surfaces. Ensure these will intersect at the necessary point, (see figure 11.16).
3. Connect the two rings with a single carabiner; ensuring the carabiner is not cross loaded. Webbing or rope could be used if the rings are turned to the inside of the intersection.
4. Test the piton pair to ensure that it is secure. If it pulls out or appears weak, move to another spot and replace it. The pair of pitons, when placed correctly, are multi-directional.

The effective time/strength for an ice piton placement is limited. The piton will heat from solar radiation or the ice can crack or soften. Solar radiation can be nearly eliminated by covering the piton(s) with ice chips or snow once they have been placed. If repeated use is necessary for one installation such as top roping, you should be inspect frequently and relocate as necessary. When an ice piton is removed, the ice that has accumulated in the tube must be removed before it freezes in position, making further use difficult.

Note: easy removal means easy failure with the ice piton; there is no friction surface to prevent it from sliding out of the hole. Although ice pitons can be used singularly, these will fail with the slightest outward force, including gravity if placed at such an angle

b. Snargs are also used to establish ice anchors. A single snarg is used for an anchor. Place the snarg at 90 degrees to the surface it is driven into. All of the same considerations listed above for the ice pitons apply to snargs.

**ELO Q**

| | |
|---|---|
| **ACTION:** | Demonstrate ice screw placements |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate ice screw placements IAW the NWTC Mountain Operations Manual |

Learning Step/Activity 1 - Ice Screw placements

a. The ice screw is the most common type of ice protection. Some screws will have longer “hangers” or handles, allowing you to easily use a hand to turn them into position. To place a screw:

1. Clear away all rotten, brittle ice from the surface and make a small hole with the ax pick to start the ice screw in.

2. Force the ice screw in until the threads catch. Turn the screw until the eye or the hanger of the ice screw is flush with the ice and pointing down. For ice that is strong (solid and well consolidated), angle the screw 15-20 degrees below a line perpendicular to the ice surface. For ice that is suspect, angle the screw 15-20 degrees above a line perpendicular to the ice surface. Bad ice can be thin, brittle, full of air pockets, or too warm.

3. While turning the screw resistance should be constant and ice should spill out of the tube as you place the screw. If at any point there is no resistance, the screw has hit an ice pocket; remove the screw and find choose another location. The pick of the ice axe can be used to assist in turning the screw.

As with ice pitons, melting of the ice around a screw over a period of time must be considered. The effective time/strength for an ice screw placement is limited. The screw will heat from solar radiation or the ice can crack or soften. Solar radiation can be nearly eliminated by covering the screw with ice chips once it has been emplaced. If repeated use is necessary for one installation such as top roping, the screws should be inspected frequently and relocated when necessary. When an ice screw is removed, the ice that has accumulated in the tube must be removed prior to further use.

**ELO R**

| | |
|---|---|
| **ACTION:** | Demonstrate a V-thread ice anchor |
| **CONDITION:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARD:** | Demonstrate a V-thread ice anchor IAW the NWTC Mountain Operations Manual |

Learning Step/Activity 1 – V-thread Ice Anchor

a. This is a very strong improvised anchor. It is a V-shaped tunnel bore into the ice using ice screws and tied off with a length of cord or webbing. Construct the anchor like this:

1. Place a long ice screw into the ice. The screw should be angled up 10 degrees and out 60 degrees to the side.

2. Back the screw out slightly. Take a second screw and place it 6-8 inches from the start of the first hole using the same 10 degree up angle and 60 degree side angle. The idea is to have the second screw meet the bottom of the hole made by the first screw; this forms a V-shape.

3. Once this is accomplished, remove both screws. Thread a wire length of cord or webbing into the hole. Using a wire hook (improvised with a coat hangar), fish out the cord or webbing and tie it off using a double fisherman or water knot. The anchor is now complete.

**SECTION IV** **SUMMARY**

**Check on Learning**

a. What are three methods of slinging a natural anchor?
Drape, wrap, and girth.

b. What knot should be used to attach the climbing rope to an anchor?
The bowline, because it is easily united.

c. What is an alternative to attaching the climbing rope to an anchor?
The tensionless anchor knot.

**Review and Summarize Lesson**

| | |
|---|---|
| **ACTION:** | Establish anchors for mountaineering applications |
| **CONDITIONS:** | Given an assortment of applicable artificial anchors, sling material, rope and terrain needed to establish the anchors |
| **STANDARDS:** | Establish anchors for mountaineering applications IAW the NWTC Mountain Operations Manual and FM 3-97.61, Military Mountaineering |

**Transition to next lesson**

As per NWTC training schedule; dependent upon course in conduct.

| SECTION V | STUDENT EVALUATION |
|---|---|
| **Testing Requirements** | Students will be tested on this task during the Mountain Stakes portion of training as per the NWTC training schedule for this course. |
| **Feedback Requirement** | Students will receive two opportunities to pass each event tested. Re-training will be conducted for students that fail the first iteration of testing. Refer to M020 for specifics. |